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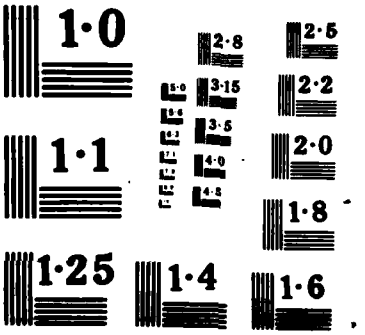
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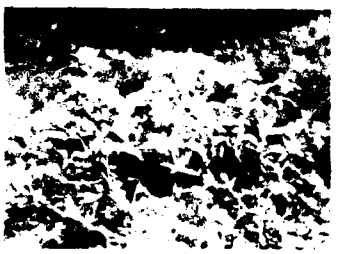

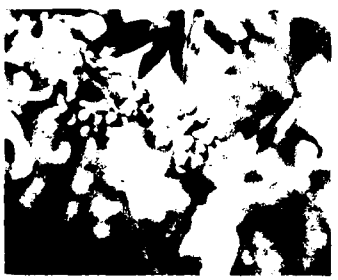

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FOURWING SALTBUSH (*Atriplex canescens*)

Section 7.5.3, US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL

by

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A plant materials report on fourwing saltbush (*Atriplex canescens*) is provided as Section 7.5.3 of the US Army Corps of Engineers Wildlife Resources Management Manual. The report was prepared as a guide to assist the Corps District or project biologist with the selection, cultivation, and management of suitable plant materials for wildlife and habitat development programs. Topics covered include description, distribution, habitat requirements, wildlife value, establishment, maintenance, and cautions and limitations.

Fourwing saltbush is a semievergreen shrub that is widely distributed in the Western United States. Saltbush provides important forage and cover for wildlife, and plants are used for windbreak plantings, erosion control, restoration of big game winter range, and reclamation of disturbed lands. The distribution and diagnostic characteristics of fourwing saltbush are described, and habitat requirements and adaptations are discussed. Procedures

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for site selection, site preparation, propagule selection, and planting are given under the heading Establishment. Maintenance requirements and tolerances to land management practices are discussed.

PREFACE

This work was sponsored by the Office, Chief of Engineers (OCE), US Army, as part of the Environmental Impact Research Program (EIRP), Work Unit 31631, entitled Management of Corps Lands for Wildlife Resource Improvement. The Technical Monitors for the study were Dr. John Bushman and Mr. Earl Eiker, OCE, and Mr. Dave Mathis, Water Resources Support Center.

This report was prepared by Mr. Clinton H. Wasser, Professor Emeritus, Range Science Department, Colorado State University, Fort Collins, Colo.; Dr. Phillip L. Dittberner, US Fish and Wildlife Service, Western Energy and Land Use Team (WELUT), Fort Collins, Colo.; and Dr. Wilma A. Mitchell, Wetlands and Terrestrial Habitat Group (WTHG), Environmental Laboratory (EL), US Army Engineer Waterways Experiment Station (WES). Mr. Chester O. Martin, Team Leader, Wildlife Resources Team, WTHG, was principal investigator for the work unit. The original report was prepared by WELUT under an Interagency Agreement with WES. Ms. Cathy Short and Ms. Pam Hutton, WELUT, assisted with manuscript preparation, and Ms. Jennifer Shoemaker, WELUT, prepared the original drawings. Review and comments were provided by Mr. Martin, WTHG, and Mr. Larry E. Marcy, Texas A&M University.

The report was prepared under the general supervision of Dr. Hanley K. Smith, Chief, WTHG, EL; Dr. Conrad J. Kirby, Chief, Environmental Resources Division, EL; and Dr. John Harrison, Chief, EL. Dr. Roger T. Saucier, WES, was Program Manager, EIRP. The report was edited by Ms. Jessica S. Ruff of the WES Publications and Graphic Arts Division.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

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NOTE TO READER

This report is designated as Section 7.5.3 in Chapter 7 -- PLANT MATERIALS, Part 7.5 -- WOODY SPECIES, of the US ARMY CORPS OF ENGINEERS WILDLIFE RESOURCES MANAGEMENT MANUAL. Each section of the manual is published as a separate Technical Report but is designed for use as a unit of the manual. For best retrieval, this report should be filed according to section number within Chapter 7.

FOURWING SALTBUSH *(Atriplex canescens)*

Section 7.5.3, US ARMY CORPS OF ENGINEERS
WILDLIFE RESOURCES MANAGEMENT MANUAL

Fourwing saltbush is a gray-green, semievergreen shrub that is widely distributed in the Western United States. It is used for windbreak plantings, erosion control, restoration of big game winter range, and reclamation of disturbed lands. The plant provides nutritious forage for livestock, browse for large and small game mammals, and food and cover for pheasants (*Phasianus colchicus*), quail (*Callipepla* spp.), and songbirds. Fourwing saltbush, also known as chamiza in the Southwest, belongs to the goosefoot family (Chenopodiaceae).

DESCRIPTION

Fourwing saltbush commonly grows from 1 to 6 ft (0.3 to 1.8 m) tall but occasionally reaches 10 ft (3 m). Shrubs have stiff woody stems with many stout gray branches and may present either a spreading or an erect growth form. The thick alternate leaves are narrow, round-tipped, 0.5 to 2 in. (1.3 to 5 cm) long, and covered with short gray hairs (Harrington 1964, SCS 1971); leaves tend to be evergreen in mild climates and deciduous in colder regions (USDA Forest Service 1937, Johnson and Anderson 1980, Wasser 1982). The root system is extensive; seedlings possess strong taproots, and mature shrubs have both abundant lateral roots and main roots up to 20 ft (6 m) in length.

Staminate and pistillate infloresences are usually borne on separate plants (Fig. 1). The small reddish-yellow male flowers are clustered in dense spikes on long terminal panicles. Inconspicuous female flowers form large, dense, spike-like panicles, in which each flower consists of only a pistil and 2 surrounding united bracts. The fruit is a 1-seeded utricle about 0.5 in. (1.3 cm) in diameter with 4 flat, protruding, papery wings from which fourwing saltbush derives its name (Harrington 1964, SCS 1971). Flowering occurs from June through September, and the fruit is borne in August and September (Vines 1960). Although the species has warm season growth habits, the times of growth and maturity vary greatly with respect to moisture cycles, altitude, latitude, and ecotype.

DISTRIBUTION

Fourwing saltbush is native to 17 Western States and is found from west Texas and the western edge of the Great Plains to southern California, western Nevada, and eastern Oregon and Washington (Fig. 1). The species grows on desert flats, mesas, ridges, and slopes at elevations of 1000 to 8500 ft; however, it is most common between 4500 and 6500 ft (SCS 1971, Wasser 1982). The major distribution is in the southwestern Great Plains, northern and central New Mexico and Arizona, and saline-alkaline sites of the Great Basin. It extends as patches and ribbons into intermountain and northern valleys and along drainages of intermittent streams (Harrington 1964, Wasser 1982).

HABITAT REQUIREMENTS

Fourwing saltbush is a component of 21 vegetation types in the Western United States (Kuchler 1964). It is dominant in the saltbush - greasewood (*Atriplex* spp. - *Sarcobatus vermiculatus*) type and subdominant in the galleta - three-awn (*Hilaria jamesii* - *Aristida* spp.) shrubsteppe type (Dittberner and Olson 1983). Common associates include blue grama (*Bouteloua gracilis*), black grama (*B. eriopoda*), alkali sacaton (*Sporobolus airoides*), inland saltgrass (*Distichlis stricta*), rubber rabbitbrush (*Chrysothamnus nauseosus*), blackbrush (*Caleogyne ramosissima*), black sagebrush (*Artemisia nova*), and bluebunch wheatgrass (*Agropyron spicatum*).

This species is adapted to arid and semiarid climates and can therefore withstand drought. Its cold tolerance is generally good but varies with geographic race and ecotype, and seedlings are often frost sensitive (Wasser

Figure 1. Distribution and characteristics of fourwing saltbush (*Atriplex canescens*): (a) fruiting branch, (b) fruit, and (c) staminate panicle (after Wasser 1982)

1982). Plants grow best in full sunlight (Shaw and Cooper 1973) and recover readily from wildfire by sprouting from rootstocks, crowns, or layers.

Soils

Fourwing saltbush is found on soils of all textures within its range. It thrives on sandy to silty loam soils with depths of 10 in. to 3 ft and forms the best stands on deep alluvial soils. This species grows well in calcareous soils and tolerates alkaline, moderately saline, and weakly sodic soils (USDA Forest Service 1936, Thornburg 1982). It has high tolerance to salt and will grow in soils with 1.0% to 1.2% soluble salt content (Blauer et al. 1976). Saltbush tolerates more boron than most cultivated plants and is a secondary or facultative absorber of selenium.

Moisture

Fourwing saltbush flourishes in zones of 8 to 15 in. mean annual precipitation but also occurs in areas that have as little as 5 in. or as much as 24 in. precipitation (Wasser 1982). The extensive, penetrating root system contributes to its drought resistance, and shrubs often remain green long after surface-rooted plants have become drought dormant.

The species cannot tolerate a high water table (Shaw and Cooper 1973). Shrubs thrive on floodplains and periodically flooded drainageways but are intolerant of standing water that lasts more than 30 hours (Aldon 1970a). Although mature plants show minimal response to irrigation, seedlings respond positively to irrigation on dry sites; however, seeds and seedlings are sensitive to the reduced soil aeration that results from flooding (Riffle and Springfield 1968, Aldon 1970a).

WILDLIFE VALUE

Fourwing saltbush provides forage for many species of wildlife; waterfowl, upland game birds, songbirds, small mammals, and hoofed browsers consume its seeds, leaves, and twigs (Martin et al. 1951). It is eaten by the desert cottontail (*Sylvilagus audubonii*) (Springfield 1970) and by the black-tailed jackrabbit (*Lepus californicus*) and antelope jackrabbit (*L. alleni*) in the Southwest (Vorhies and Taylor 1933). Saltbush is palatable year-round (Springfield and Housley 1952) and is a preferred forage of elk (*Cervus elaphus*) in winter and of pronghorn (*Antilocapra americana*) and deer (*Odocoileus* spp.) during all seasons (Shaw and Cooper 1973).

Saltbush is rated as good to fair forage for sheep, goats, and deer (Sampson and Jesperson 1963). Its nutrient content compares favorably with alfalfa (*Medicago sativa*) in crude protein, calcium, phosphorus, and crude fiber (Watkins 1943, Costello 1944). Sodium content varies with site and season; this probably results from periodic sloughing of the leaf trichomes, which concentrate salt, and may account for its varying palatability (Wasser 1982).

Quail use fourwing saltbush for food and cover (McMillan 1960, Aldon 1970c), and several studies have shown that saltbush habitat can be improved to enhance quail populations. A grass-shrub range in northern Arizona, where western wheatgrass (*Agropyron smithii*) and saltbush were major components, responded with increased cover values and bird populations following irrigation and regulated grazing (Monson 1941). Anderson et al. (1978) modeled the revegetation of a lower Colorado River floodplain for birds that utilized fourwing saltbush instead of quailbush (*Atriplex lentiformis*) and found that the Gambel's quail (*Callipepla gambelii*) population increased in 1 year. Saltbush has also been planted in multirow windbreaks to provide winter protection for sharp-tailed grouse (*Tympanuchus phasianellus*) and pheasants in the Great Plains and Intermountain West (Kimball et al. 1956, Evans and Cruse 1971).

ESTABLISHMENT

Site Selection

The following criteria indicate that a site is suitable for the establishment of fourwing saltbush: (1) soils are moderately saline or alkaline, deep, and friable; (2) mean annual precipitation is from 8 to 15 in.; (3) terrain is alluvial plain or of shallow gradient; and (4) the area has had vigorous stands of saltbush but currently lacks adequate forage and cover (Plummer et al. 1968). Floodplains adjacent to riparian habitat in the 8- to 15-in. precipitation zone should be considered if these lack sufficient quail and rabbit cover (Anderson et al. 1979). Other suitable sites are areas with mine spoils, irrigation systems, inadequate soil stabilization, desilting vegetation cover, or any disturbed soils that meet the habitat requirements of the species (Aldon 1970a, 1978). Saltbush should not be planted in dense woodlands or on shallow, rocky sites, acidic soils, or north-facing slopes with gradients greater than 30%.

Site Preparation

Plot design. Plot size and shape will depend on the pattern and extent of suitable sites. Plots should be elongate, parallel to contours, and irregular in outline. The width of clearings in tall brush or woodlands should be no more than 400 yd and preferably less than 185 yd. Generally, conversions in woody cover types should not exceed 170 acres; a maximum of 90 acres is recommended for the Southwest (USDA Forest Service 1969). Corridor cover plantings for big game need to be 50 yd wide, whereas 3 or 4 rows of low shrubs may provide sufficient travel lane cover for birds and small game.

Yoakum et al. (1980) set an upper limit of 1000 acres for pronghorn range restoration projects with two-thirds of the range left untreated. For Gambel's quail cover in reaches of the lower Colorado River, Anderson et al. (1979) proposed planting fourwing saltbush as the dominant species in 0.2-acre plots and as mixed plantings with cottonwoods (*Populus* spp.), willows (*Salix* spp.), honey mesquite (*Prosopis juliflora*), and quailbush.

Mechanical treatment. Saltbush seedlings are weak competitors; therefore, grasses, forbs, and shrubs should be reduced to a minimum before seeding (Plummer et al. 1968, Springfield 1970). Burning of nonsprouting brush is sometimes feasible under controlled conditions on carefully selected sites (Plummer et al. 1968). Level sites that are not too erosive can be plowed, or .sked and harrowed, and allowed to settle before seeding or cultipacking.

Equipment that can prepare the soil and plant seed in a single operation should be used on level, rock-free, grassland sites. These include rotoseeders; deep-furrow drills; and scalpers, drills, and interseeders equipped with sod-cutting coulters, shovels, or duckfoot blades. Rougher rangelands will probably require the use of brushland plows on moderate slopes and anchor chain drags on steeper slopes. This type of site preparation is usually done in late summer or early fall before late fall, winter, or spring seeding.

Soil amendments. The application of fertilizer before or during seedling establishment encourages weed growth and is therefore recommended only for highly disturbed sites. Soil fertility should be tested so that needed fertilizer can be placed in the root zone during site preparation (Merkel and Currier 1973).

Propagule Selection

Fourwing saltbush can be established from either seeds or seedlings. Seeding is much cheaper and is satisfactory for extensive rangeland improvement, but well-established stands can be obtained several years earlier with seedlings. This may be important on highly erosive sites, such as mine spoils and construction sites (Aldon 1978). Although growth from seeds is fairly rapid (6 to 12 in. per year), plants require from 6 to 10 years to reach full cover and reproduce vigorously. Using seedlings can reduce this time by 50% and result in better stand survival (Cassady 1937, Aldon 1970c, Springfield 1970).

Cultivars. Several varieties of fourwing saltbush are planted in the Western States. Marana is used in California. Wytana, a dwarf cultivar suitable for row planting and mechanical harvest, is adapted to Montana, eastern Wyoming, and the western Dakotas and is useful in mine spoil reclamation because of its strong seedling vigor. The strain T-3553 was developed from stands on the Santa Rita Experimental Range in southern Arizona and is being tested for use in wildlife habitat improvement in the Southwest; this cultivar is not adapted to sites above 4900 ft in elevation.

Seed selection. Saltbush seeds can usually be obtained from commercial sources. It is preferable to use seeds of locally adapted strains or those from sources north of the planting site, as those from more southern sources may be sensitive to late spring frosts (Springfield 1970). If site-specific strains are scarce or unavailable, seeds may be harvested from available stands in the area; a plant materials specialist may help find local sources.

Harvesting can be accomplished by vacuuming or by shaking or hand-stripping seeds into bags or baskets or onto canvasses. Hammermilling at 1500 rpm with 1/4-in. wire mesh will dewing the seeds, making them easier to handle in planting. Hammermilling will also enhance germination and may increase the duration of viability, which usually lasts 6 to 7 years. Although seed quality is not standardized, acceptable purity is 95%. Fourwing saltbush has approximately 52,000 dewinged seeds or 25,000 intact seeds per pound (Wasser 1982).

Germination and vigor. Germination rate is highly variable: California seed had 44% germination in 30 days; New Mexico seed had 70% to 95% germination in 30 to 34 days; and Utah seed showed 53% germination in 50 days (Vories 1981). Seedling vigor is excellent, and 18-in. plants are not uncommon at the

end of the first growing season in the northern Great Plains (Thornburg 1982). At least 3 years are required for establishment and reproduction of fourwing saltbush under rangeland conditions (Plummer et al. 1968, Springfield 1970).

Planting Methods

Time of seeding. Seeding success depends chiefly upon the presence of adequate soil moisture when temperatures are favorable for rapid germination and seedling growth. Optimum temperatures for germination range from 55° to 75° F (Springfield 1970), and moisture conditions are optimum near field capacity at 1 to 2 atmospheres of moisture stress (Aldon 1978). The best time to seed varies regionally; it occurs during spring in Utah (Plummer et al. 1968) and Colorado (Hervey 1955) and after killing frosts in the spring or from late July through August in the Southwest (Springfield 1970). Aldon (1978) suggested waiting until late summer when there is at least a 50% chance of a 0.4-in. rain a few days before planting. Satisfactory stands often result from late fall and winter seedings in the Intermountain West (Plummer et al. 1968).

Seeding. Seeds can be broadcast or drilled in rows. Drilling requires less seed than broadcasting and can be done with a rangeland drill. The seeding rate is 4 to 8 lb of dewinged seeds or 8 to 15 lb of winged seeds per acre (Springfield 1970). Seeds should be sown in well-prepared seedbeds with rows 18 to 35 in. wide; less spacing may result in too much seedling competition, but row spacings greater than 18 in. may enhance weed growth under good moisture conditions. Seeds should be covered only 0.5 in. deep in firm seedbeds on fine-textured soils and no deeper than 1.5 in. in loose seedbeds on coarser soils. Mulching immediately after seeding conserves moisture and improves seedling establishment. Straw, native grass hay, and chemicals that lower the surface soil temperature are satisfactory mulches.

Broadcasting is commonly done by airplane after site preparation or between two chaining or pipe-harrowing operations so that the second run covers the seed with soil and mulch. The rate of seeding should be increased by 50% to 100% over that recommended for drill-seeding; therefore, from 6 to 16 lb of dewinged seeds or 12 to 30 lb of winged seeds per acre will be required for broadcasting (Springfield 1970, Wasser 1982). Seeds can also be broadcast into the deep cleat marks left at tractor turnaround sites (Plummer et al. 1968).

Two other methods have been suggested for sowing fourwing saltbush. A tractor-mounted dribbler can drop seeds onto the tracks and press them into the soil (Plummer et al. 1968), and seeds can be sown directly into heavy grass sod by placing them in 30-in.-wide × 9-in.-deep scalps made with a fire plow (Stevens et al. 1981).

Transplanting. Planting seedlings on disturbed or highly erosive sites is sometimes feasible. Recommendations by Aldon (1970b) for projects in New Mexico may be applicable for many sites in the Southwest and include the following suggestions. Periodically flooded areas can be planted with saltbush if inundation lasts no longer than 30 hours. Whenever possible, the seedlings to be used should be grown from seeds collected from a local source or a site similar to the one to be planted.

The best time to transplant is late July or early August when soils are moist. To minimize stress, seedlings should be kept wrapped, or shaded and moist, and set out before midmorning. Each seedling should be placed in a 4-in.-deep hole that is covered and tamped very lightly. Care should be taken to prevent injury to the roots, which will tolerate bending when damp. Transplants should be spaced 5 ft apart and mulched with straw or grass hay to moderate the temperature and conserve moisture. It may be desirable to spray the seedlings and mulch with a 1:1 mixture of water and animal repellent.

Planting mixtures. Seedings of fourwing saltbush for game range restoration usually include a legume, grasses, forbs, and other shrubs. These mixtures provide a diversity of species, which aids in more rapid site stabilization than would a monoculture of saltbush. Plummer et al. (1968) and Yoakum et al. (1980) recommended mixtures with 1 to 6 species each of shrubs, grasses, and forbs for use in Utah and the Intermountain West. The rate for Utah seedings is 0.5 to 5 lb of saltbush seeds in 10 to 30 lb of mixture per acre. The higher rates are applicable in blackbrush ecotypes and for broadcasting; rates of 0.5 to 2 lb saltbush seeds per acre are more commonly used in other vegetation types (Plummer et al. 1968, Springfield 1970).

MAINTENANCE

Fourwing saltbush requires from 3 to 5 years to become well established, and livestock grazing should be withheld during this period (Cassady 1937). After establishment, a grazing regime can be implemented; either winter grazing or a deferred rotation system will allow saltbush to produce a maximum

yield of forage for livestock. Recommended grazing use is 40% of the total annual growth during the growing season and 50% during winter dormancy (SCS 1971). Saltbush is well adapted for winter use. It is more tolerant of defoliation at this time, and its nutritive quality remains fairly high. In late fall and winter, when the crude protein of grasses has dropped to 3% or 4%, saltbush leaves and stems contain from 8% to 12% crude protein (Costello 1944).

As fourwing saltbush is tolerant of disturbances such as bulldozing and fire, these techniques can be used to rejuvenate stands that are declining in vigor or being suppressed by less tolerant species (Martin and Cable 1973, Wright and Bailey 1982). Springfield (1970) recommended furrowing and pitting to aid the recovery of thin stands of saltbush. To obtain full stand development on disturbed sites, soil moisture should be carefully monitored during the first growing season, and moisture stress should be kept at 1 atmosphere. If irrigation is necessary to achieve this goal, plants should not be inundated for more than 30 hours.

CAUTIONS AND LIMITATIONS

Seedlings are vulnerable to grasshopper damage in the cotyledon stage, and juvenile stands are often injured by rodents and rabbits (Springfield 1970). Plants are especially palatable to deer during the winter, and a large concentration of deer can deplete an area of saltbush (SCS 1971). Therefore, animal activity should be monitored and corrective action taken before serious losses occur. Repellents can be used to reduce losses from herbivores (Springfield 1970). Selenium absorption by fourwing saltbush may render plants toxic to animals if this species constitutes the total diet or a major portion of it (Blauer et al. 1976).

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